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AUTHOR Packard, Abbot L.; And Others
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ABSTRACT

This document discusses strategies for using computer-assisted instruction to introduce graduate students in education to research and statistics. The plan's criteria for an ideal learning environment, including individualized self-paced progress, a hierarchy of well-organized and well-articulated goals, and multiple cues leading to goal attainment with feedback mechanisms for each cue, are based on Brunswik's probabilistic theories of human behavior. Pilot studies were done in screen design and in the integration of text, audio, graphics, and even animation. One of the most important objectives in developing a computer-assisted learning environment is giving learners power over how quickly and by what medium they receive knowledge. (Contains 17 references.) (BEW)

Evolution Of A Instructional Design

Abbot L. Packard
Glen A. Holmes
Jimmie C. Fortune
Virginia Polytechnic Institute and State University

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We have been collaborating in the creation of an affective and effective user friendly teaching tool for an introduction to research and statistics for the graduate Education students. We set a goal of answering criticism of the current courses in statistics and research and to begin to create a different learning environment. This goal leads us to explore a psychological theory of learning based upon Brunswik psychology that provide the means to addresses most of these criticisms. Brunswik (1956) criticizes a one-dimensional behaviorism for expecting too much uniformity in theoretically discussing human behavior. He asserted that human behavior should be treated as probabilistic, as opposed to the customary treatment as deterministic. His theory suggests the development of a learning environment rather than a teaching environment. This environment would contain a variety of "cues' (Brunswik might have spoken about cues as a motivating stimuli). To develop this environment the curriculum has to be defined in discrete units, has to be carefully sequenced, and has to be clearly articulated. Also, a medium to deliver the curriculum has to be chosen.

The ideal learning environment would be rich in cues delivered in a variety of mediums to adjust for the wide variety of learning styles. Computer technology has been used as a medium for remedial work with learners and to supplement regular instructional programs (O'Hare and Patton, 1992; Mavs and Lumsden, 1989). Furthermore, computer assisted instruction may benefit students by empowering them to choose how they

learn. Do students become more independent while expanding their normal thought processes and building their confidence as self-directed learners? The multimedia computer learning environment can provide instruction through various mediums such as text, audio, visual spatial and interactivity allowing the student to become less anxious as well as more involved in the process. The choice of Brunswik as a basis for these learning environments can be explained by describing the nine building blocks that are required to define the space. These building blocks contain contemporary reforms such as self-pacing or continuous progress study, instructional sets, cognitive closure, use of various feedback loops, accommodations of differential learning styles, use of alternate learning paths, etc. The difference in the proposed program compared to the traditional design is that each of these components comes as a part of a single independent, internally consistent theory and is designed to work interdependent with the other components. Hence, one is not looking at the effects of a continuous progress curriculum, which is set, but one is looking at a system that includes a continuous and evolving progress curriculum flexibly designed to address long term goal characteristics, such as all the work involve in getting a degree. The process can be assisted by advanced organizers, alternate routes, feedback loops and closure.

The building blocks include:

1. An environment or ecology that permits student initiated and self-paced instruction.
2. A hierarchy of goals ordered by time, distance and

importance.

3. A method of articulating and emphasizing distal goals (advanced organizers or set determiners).
4. Multiple cues placed in the environment that lead to goal attainment.
5. Multiple paths to goal attainment.
6. Feedback mechanisms for each cue.
7. Consideration of regional referencing of factors influencing goal attainment in the design of cues.
8. Opportunity to learn language and syntax of the knowledge department.
9. Individualized expectations with regard to selection of cues, pace and path to goal attainment (variable entrance and exit points).

These teaching environments have been created as products of knowledge, as well as errors. After each unit has been tested, the feedback, from ourselves looking backwards and the feedback from the students, has been instrumental in forming the next step.

Learning environments

Granny and the Blackboard

The first attempt was to look at the potential of using computer assisted instruction to perform as remediation tool, a willing tutor, and a non-judgmental instructor. A background in instructional design gave great confidence to the instructors to think they had the able to create an environment capable of delivering knowledge. That is, until the first design attempt is made. The first screen design included what we affectionately call

"granny and the blackboard.". It was decided to add a little levity to the design as the subject matter of statistics has produced anxiety in many older Educational The "Granny" screen design was not well received by the group of students who critiqued the first attempts.

Further preliminary investigation provided opportunities to explore issues (choices of medium, screen design, use of feedback, interaction strategies) related to the development of the module system. These questions were unresolved and would be pursued over the following attempts to design an environment that would aid students. What choices of medium (textual, static graphics, animated graphics, audio, and or any combination) should be used to present the material?

Screen design became very important as was quickly realized. Too novel or too difficult and the instruction was lost. The key was to develop a design that was fluent and as seamless as possible. A study by Aspillaga (1991) looked at the retention affected by the screen location of information displayed. Results indicated that displaying information at a consistent location or relevant to graphic information facilitates learning. A later study (Aspillaga, 1992) continues the recommendations pointing out the need for placement, use of upper versus lower case, and "the screen page as a unit."

What feedback? What interactions? The first study left a lot of questions to be answered rather than a few answered.

Multimedia

This pilot study investigated the design and implementation issues regarding a computer remediated program. Brunswik paradigms provided the conceptual framework (content selection, sequencing of instruction events, practice opportunities, feedback strategies) to create the learning environment. Ideally, in accordance with the Brunswikian approach, it was hoped that students would be able to choose from several methods as to how they wished to receive instruction. Three different instructional strategies were designed: a simulation (text, graphics and interactions); lecture (text graphics, video vignettes and interaction- "talking head"), and lecture (text gra hics, audio vignettes and interaction- (invisible talking head"). The audio was often preferred if they could follow later with the textual presentation allowing self-paced review of the same material. The "talking heads" modules were time sequences much like a lecture class would be if the class were without interruption. Many stated that the video of the talking head was too distracting and took away from the textual material. If the audio was segmented so the learner could chose to stop, reply and jump from place to place it may have been better received. This supports the practical approach suggested by Rathbun and Foreman (1990) with regard to the optimization of the language components.

Animation

How much can a student imply when relying on static graphic or animate graphic? Information is process through the use of multiple senses (Paivio, 1991). In the learning environment, how much can be attributed to one sense? From the studies of others who used a combination of both textual and graphics to present new material, we can draw the assumption that both are better. These studies (Cooper and Shepard, 1973; Surber and Leeder, 1988 and Rieber and Kini, 1991) have stated the advantages of both but have left questions about the amount of text and/or graphics,

The purpose then of this pilot study was to gather evidence that might support further investigation regarding the differences between using static and animated graphics in an instructional setting. The goal of the study was not to establish any statistical significance; rather, to observe the effects of graphic presentation and inference gained by the participants. Only in one question was there found evidence which supported that one method was superior overall then another. The question contained a static graphic representation of an interaction and those who did not have to deduce the answer did better. The animated instruction students were forced to reason the answer and did not fare as well.

Overall, while no conclusive results occurred, it also can be implied that the type of assessment which will be used can distinguish between the encoding level which has occurred and perhaps should follow the form of the

instruction. The pilot study also did not put importance on the material being presented leaving the participants without cause to attend as they might if was important to their goals.

Static with text versus Animation with text

This pilot study is the second in the series aimed at the specific task of learning statistical concepts associated with the analysis of variance (ANOVA) and, more specifically, graphic interactions. In additional to the graphic information that was received in the first study, this study added textual material to the graphic display. It was to be expected that the more information and more options to gain that information would greatly benefit the student. Once again the information that was gathered was not to suggest one format better than another but to look at the reactions of the participants and use their feedback to further develop the modular system. It can be generally understood that graphics with text enables the students to encode information better.

Cognitive Aptitude Interactions

As the pilot studies have proceeded, consideration of the cognitive differences among the individuals have be investigated. In recent research

the effectiveness of hypermedia-based instruction varies by the leaner characteristic (Weller, Repman, Lan and Rooze, 1994). Three different cognitive abilities have been the focus of other researchers (Spatial visual skills, Field independence/field dependence and Locus of control). Results of a study by Juhel (1991) showed that spatial thinking is in part supported by visual memory. A recent study demonstrated the relationship between the students' information accessing behavior were different between field independence students then those measuring as field dependent (Weller, Reprman and Rooze, 1991).

Wesley, Krockover and Hicks (1985) presented findings suggesting that computer - literacy is more important for the external control student when approaching a computer assisted instruction module. Another study (Klein and Keller, 1990) indicated that type of locus of control influenced both performance and confidence of the student.

It is to be expected that these cognitive difference will create individuals to preferred some mediums versus others. At this juncture, the study continues to create a series of modular units allowing for individual differences.

Conclusions

The findings at the end of each of the five pilot studies has added to the existing knowledge. This knowledge has helped the designing process evolve, allowing the design to depart greatly from "Granny". This

evolvement has become a simpler design rather then more ornate. The delivery of text and graphics is now quickly interchangeable both in content as well as in position on the screen helping the design tool to become more universal. The module now can be transported from one place to another with greater ease. It has become more user friendly. All these improvements have made a better model, and yet this model is far from finished.

Voices of caution (Clark, R. E.,1985; Reeves,T. C., 1993) have warned about taking to much credence in the published researcher dealing with CAI. Listening to their concern about proper methodology, these five pilot studies would fall into the category of "pseudoscience" and have been just peeks into the possible world of using CAI modules to present knowledge. The development of a semester long course supplement and its assessment throughout the semester both on short term as well as long term recall are needed. It is only after an extended use that the term "novelty" will disappear. It will be only after the students are exposed for a semester will the statements "I was helped to process and better understand" and "I could review at my own pace" will have substantial meaning.

These pieces of research have required the interaction between instructional designers, programmers, and students. The research has progress in stages and continues today. The goal has been designed around Brunswik psychology of creating a learning environment rather than a teaching environment. There has been progress toward this goal of creating

an adaptable environment that will allow students to have a choice of relevant examples, a choice of environment through which to receive knowledge, a choice to pace the learning and a choice of time of delivery.

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